LAFARGE
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Document #: JPA-K1-SCR-OR-001

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January 16th, 2014

Phillip Brooks
Air Enforcement Division Director
U.S. Environmental Protection Agency
MC 2242A
1200 Pennsylvania Ave.
Washington, D.C. 20460

Object: Lafarge – U.S. EPA Consent Decree - Joppa, IL facility – Optimization Report

Dear Mr. Brooks,

Pursuant to section XI (review and approval of submittals) of the Lafarge - U.S. EPA Consent Decree and pursuant to paragraph 12 of the Consent Decree Appendix, please find herewith the Optimization Report for our Joppa, IL facility pertaining to the installation of a Selective Catalytic Reduction (SCR) control technology on Kiln 1.

This Optimization Report contains a specification of reagent rates and molar ratios which Lafarge believe is proprietary information and that should be treated as confidential business information. Additionally, Appendix A of the report contains information which parallels the information contained in the baseline data collection report. As a consequence, Lafarge would ask that this information be treated as confidential business information under 40 CFR Part 2.

Respectfully submitted,

Jean-Francois Latimier
Compliance Director, EPA projects

cc: per transmittal form attached

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LAFARGE – U.S. EPA CONSENT DECREE		***Date:***	Jan 16, 2014
		Affected Plant:	Joppa, IL
Issued to:	U.S. EPA MC 2242A 1200 Pennsylvania Ave. NW Washington, D.C. 20460	***Attention:***	**Phillip Brooks**

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Project File	Hard copy	Lafarge North America Inc.	Alpharetta, GA

DOCUMENTS

DOCUMENT NO.	DOCUMENT NAME	DOCUMENT DESCRIPTION
JPA-K1-SCR-OR-001	JPA-K1-SCR-Optimization Report – rev0	Optimization Report for Joppa K1 SNCR – Revision 0

LAFARGE - U.S. EPA Consent Decree Optimization Report

Plant: Joppa
Affected state: Illinois
Affected kiln: K1
Pollutant: Nitrogen oxides (NO_x)
Control technology: Selective Catalytic Reduction

Table of Contents

1. Introduction

Pursuant to the terms of the Consent Decree between the Lafarge Companies, the United States and certain Affected States, several of Lafarge's U.S. cement plants are required to implement various control technologies on certain kilns in order to reduce sulfur dioxide (SO_2) and/or nitrogen oxide (NO_x) emissions.

A requirement of the Consent Decree is the submittal of a control technology start-up and optimization program protocol for certain affected kilns for each control technology. This document is the optimization report covering the NO_x control technology requirement prescribed for the Joppa kiln #1 (K1), under Section V. A. Paragraph 34 of the Consent Decree. The specified technology for this kiln is selective catalytic reduction (SCR).

The following summarizes Section IV of the Appendix to the Consent Decree, describing the requirements of the optimization program.

- The start-up of each control technology will include any shake-down of newly installed equipment.
- Optimization efforts shall begin immediately upon commencement of continuous operation of the control technology.
- Start-up and optimization shall last no longer than six operating months.
- An optimization program protocol shall be submitted to the U.S. EPA no later than 90 days prior to the commencement of continuous operation.
- Optimization efforts will focus on minimizing NO_x emissions to the greatest extent practicable.
- The protocol shall describe procedures that shall be used to evaluate the impact of different Control Technology operating parameters on the rate of emission reduction achieved by each applicable Control Technology. See Section 3 below – *Protocol Procedures* for the complete list of items the protocol shall contain.
- An optimization report will be submitted within 30 days following the optimization period.
  - The report will demonstrate conformance with the optimization protocol.
  - The report will establish the operating parameters for the control technology during the demonstration period.
  - The report will include a discussion of any problems encountered with the operation of the control technology and the impact, if any, the control technology may have had on changes in the emissions from the kiln.
- The SCR system shall be deemed optimized if the optimization report demonstrates that the control technology has achieved a reduction in the rate of emission of NO_x (lb/ton clinker) of no less than 80%, or the removal achievable based on the vendor's recommended design, as compared to baseline data.
  - The design report for Joppa K1 SCR was approved by EPA and IEPA on 25 January 2011.
  - The Optimization protocol for Joppa K1 SCR was approved by EPA and IEPA on 01 April 2013.
  - A kiln may be deemed to be optimized at a lower reduction rate if it can be demonstrated that a higher reduction rate (i.e. higher reagent addition) cannot be sustained due to negative impacts on product quality, kiln reliability, and/or compliance with other emission requirements or the control technology cannot sustain operation at the design values.

2. Commencement of Operations

The Joppa plant commenced continuous operation of the SCR technology on Kiln 1 (K1) on 31 July 2013, meeting the deadline specified in Paragraph 34 of the Consent Decree.

3. Conformance with the Optimization Protocol

The procedures outlined in the approved Optimization Protocol were followed to establish the operating parameters for the SCR system on the Joppa kiln (K1).

a. *The steps taken to commence Continuous Operation of the Control Technology;*

Prior to 31 July 2013, the following steps were taken in order to begin continuous operation of the SCR system:

- Equipment check-out (motor starts, rotation, etc.)
- Ensure SCR system I/O is integrated into plant process control system
- Calibrate the reagent flow meter

b. *The initial reagent injection rate (as a molar ratio of the average pollutant concentration) for each Control Technology;*

Per the Baseline Data Collection report submitted on 13 February 2013 (document # JPA-K1-SCR-BD-001) the average uncontrolled NO_x emission for K1 for the 180 operating days period spanning from 17 June 2012 through 26 January 2013 was [redacted]

The selected reagent is [redacted]

In accordance with the approved optimization protocol, the initial reagent injection rate was [redacted]

c. *Sampling and testing programs undertaken during the Optimization Period;*

The plant has continued to follow their routine data collection program for operating parameters, gas composition and emissions. Data collected during the Optimization Period are presented in Appendix A in a format similar to the Baseline Data.

The plant has also continued to follow their routine sampling and chemical/physical testing program for raw, intermediate and finished products, e.g. limestone, raw meal (kiln feed), clinker, cement, etc. Over the limited duration of the tests, no adverse physical or chemical affects from aqueous ammonia injection were observed from routine chemical and physical analytical results.

d. *A plan to increase the reagent injection rate for each Control Technology and associated sampling and testing programs for each increase in the reagent rate;*

Tests were carried out at several reagent injection rates identified in the Optimization Protocol until the average [redacted] as compared to the average uncontrolled NOx during BDC. Each reagent rate was held for 2-4 weeks. Reagent was injected following this schedule (10.6 lpm represents the design injection rate):

- [redacted] from 31 Jul 2013 to 14 Aug 2013
- from 15 Aug 2013 to 28 Aug 2013
- from 29 Aug 2013 to 08 Oct 2013

- Non-Responsive [redacted]rom 09 Oct 2013 to 18 Nov 2013
- [redacted]rom 19 Nov 2013 to 03 Dec 2013
- [redacted] from 04 Dec 2013 to 17 Dec 2013

e. *The factors that will determine the maximum reagent injection rates and pollutant emission rates for each Control Technology (including maintenance of Kiln productivity and product quality);*

The primary factors that have been used to determine the maximum reagent rate and pollutant emission rates for SCR on Joppa K1 are:

- **Health and safety** – Plant personnel received site specific training on receiving, handling, storage, and spill response for aqueous ammonia. Local emergency response personnel have been trained on handling aqueous ammonia spills. An eye wash station, emergency shower, and spill kit are located inside the ammonia pump house. An ammonia leak sensor is installed inside the ammonia pump house. The Material Safety Data Sheet (MSDS) for aqueous ammonia is located on the 3E[1] web site. Safety interlocks and alarms are programmed and have been tested. Labels have been installed on equipment, piping and instrumentation.

- **Environmental compliance** – Routine emissions (as measured by Continuous Emissions Monitoring Systems and calculated in the Data Acquisition System) are discussed in Section 5.

- **Products' quality** (standards as well as customer expectations) – Product quality standards, as specified by our customers, were maintained during the Optimization Period. The plant maintained consistent quality and no complaints were noted by plant personnel or customers.

- **Kiln productivity** (production rate, stability, etc.) – The Demonstration Period will provide a better understanding of the impact of the environmental control technologies on kiln productivity.

- **Kiln reliability** (i.e. maintaining good uptime) – There were no kiln outages attributable to the SCR system during the Optimization Period.

f. *Evaluation of any observed synergistic effects on Kiln emissions, Kiln Operation or product quality from Control Technologies for NO_x, SO_2 and particulates;*

No synergistic effects in kiln emissions, operation or product quality were identified during the limited duration of these tests.

[1] 3E Online is a third party vendor which provides online access to a customer's hazardous material inventory and associated Material Safety Data Sheets MSDS; http://www.3eonline.com

g. *Evaluation of the cost effectiveness of the incremental addition of reagent(s) and any incremental reduction in emissions of an air contaminant;*

Aqueous ammonia used during the Optimization Period was [redacted] and cost [redacted]. This results in the following costs (assuming 100% operating time):

Molar Ratio	Daily Cost	Annual Cost	Cost per ton NO_x Reduced
[redacted]			

Power and maintenance costs related to the SCR system may add [redacted] annually to these operating costs.

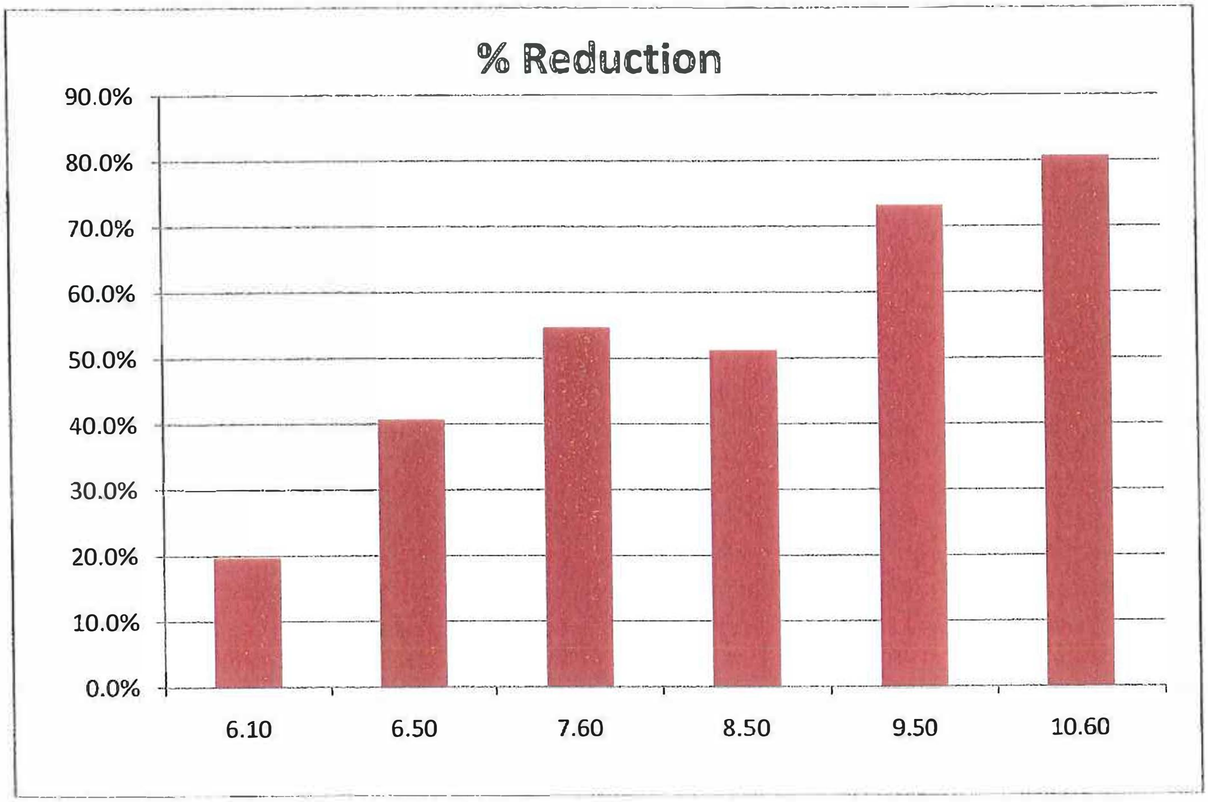
4. Description of Operational Problems Encountered

During the optimization period, the SCR control technology performed well and no operational problem was encountered. During a kiln shutdown, an inspection of the catalyst layers revealed some dust accumulation in a few areas on top of the catalysts. A defective control valve on the cleaning cycles was replaced and as a whole, the Soot blowers did an effective job in keeping the top of the catalyst layers free of blockages.

5. Impact on Emissions from the Kiln

The table below summarizes the NO_x emissions reduction during the Optimization Period from an average baseline value of [redacted] of uncontrolled NO_x to average values of NO_x shown on the table below at the respective injection rates

Injection rate		NO_x intensity
L/min	Molar ratio	lb/t clinker
[redacted]		



6. Operating Parameters Selected for the Demonstration Phase

During the Optimization Period, NO_x emissions reduction improved progressively with increasing ammonia reagent injection rate. A reduction of greater than [redacted] NO_x emissions was achieved at the design ammonia injection rate [redacted] equivalent to [redacted] molar ratio.

During the Demonstration Period, Lafarge recommends to maintain reagent injection at the rate of [redacted], equivalent to [redacted] ratio based on the results during the Optimization Period.

Appendix A: Data Collection

LAFARGE CEMENT	Optimization Report Selective Catalytic Reduction	Plant: Joppa	
		Revision:	0

U.S. EPA Consent Decree
Demonstration Data Collection

Kiln 1 SCR Optimization Report

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Joppa
Grand Chain, Illinois
K1

Data collection start date:	31	July	2013
Data collection end date:	17	December	2013
Submittal date:	16	January	2014

Non-Responsive

Non-Responsive

Appendix § III paragraph 8:		a	b	c	d						e				f	h	i	j	
					Raw material proportions													Fuel rates	
Operating days	Date	Stack temperature [°F]	Kiln (clinker) production [ton/d]	Raw meal (kiln feed) rate [ton/d]	Limestone [% mass, wet]	Alumina [% mass, wet]	Iron [% mass, wet]	Sand [% mass, wet]	In-house recycle [% mass, wet]	Total raw material feed rate (to RM) [ton/d, wet]	Stack NO_x [ppmvd]	[lb/d]	Stack SO_2 [ppmvd]	[lb/d]	Flue gas flow rate [acfm, dry]	Kiln feed burnability	Burning zone temperature [°C]	Coal [tonne/h] [as-fired]	Coke [tonne/h] [as-fired]
1	2013.07.31	Non-Responsive [redacted]																	
2	2013.08.01																		
3	2013.08.02																		
4	2013.08.03																		
5	2013.08.04																		
6	2013.08.05																		
7	2013.08.06																		
8	2013.08.07																		
9	2013.08.08																		
10	2013.08.09																		
11	2013.08.10																		
12	2013.08.11																		
13	2013.08.12																		
14	2013.08.13																		
15	2013.08.14																		
16	2013.08.15																		
17	2013.08.16																		
18	2013.08.17																		
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22	2013.08.21																		
23	2013.08.22																		
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25	2013.08.24																		
26	2013.08.25																		
27	2013.08.26																		
28	2013.08.27																		
29	2013.08.28																		
30	2013.08.29																		
31	2013.08.30																		
32	2013.08.31																		
33	2013.09.01																		
34	2013.09.02																		
35	2013.09.03																		
	2013.09.04																		
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	2013.09.14																		
	2013.09.15																		
	2013.09.16																		

U.S. EPA Consent Decree
Demonstration Data Collection

Kiln 1 SCR Optimization Report

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Joppa
Grand Chain, Illinois
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Data collection start date:	31	July	2013
Data collection end date:	17	December	2013
Submittal date:	16	January	2014

Appendix § III paragraph 8:		a	b	c	d						e				f	h	i	j	
				Raw meal (kiln feed) rate	Raw material proportions					Total raw material feed rate (to RM)	Stack NO_x		Stack SO_2					Fuel rates	
Operating days	Date	Stack temperature [°F]	Kiln (clinker) production [ton/d]	[ton/d]	Limestone [% mass, wet]	Alumina [% mass, wet]	Iron [% mass, wet]	Sand [% mass, wet]	In-house recycle [% mass, wet]	[ton/d, wet]	[ppmvd]	[lb/d]	[ppmvd]	[lb/d]	Flue gas flow rate [acfm, dry]	Kiln feed burnability [—]	Burning zone temperature [°C]	Coal [tonne/h] [as-fired]	Coke [tonne/h] [as-fired]

Operating days	Date
	2013.09.17
36	2013.09.18
37	2013.09.19
38	2013.09.20
39	2013.09.21
40	2013.09.22
41	2013.09.23
42	2013.09.24
43	2013.09.25
44	2013.09.26
45	2013.09.27
46	2013.09.28
47	2013.09.29
48	2013.09.30
49	2013.10.01
50	2013.10.02
51	2013.10.03
52	2013.10.04
53	2013.10.05
54	2013.10.06
55	2013.10.07
56	2013.10.08
57	2013.10.09
58	2013.10.10
59	2013.10.11
60	2013.10.12
61	2013.10.13
62	2013.10.14
63	2013.10.15
64	2013.10.16
65	2013.10.17
66	2013.10.18
67	2013.10.19
68	2013.10.20
69	2013.10.21
70	2013.10.22
71	2013.10.23
	2013.10.24
	2013.10.25
	2013.10.26
	2013.10.27
	2013.10.28
	2013.10.29
	2013.10.30
	2013.10.31
	2013.11.01
	2013.11.02
	2013.11.03

Non-Responsive

[redacted]

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Appendix § III paragraph 8:		a	b	c	d						e				f	h	i		
				Raw meal	Raw material proportions					Total raw								Fuel rates	
Operating days	Date	Stack temperature [°F]	Kiln (clinker) production [ton/d]	(kiln feed) rate [ton/d]	Limestone [% mass, wet]	Alumina [% mass, wet]	Iron [% mass, wet]	Sand [% mass, wet]	In-house recycle [% mass, wet]	material feed rate (to RM) [ton/d, wet]	Stack NO_x [ppmvd]	[lb/d]	Stack SO_2 [ppmvd]	[lb/d]	Flue gas flow rate [acfm, dry]	Kiln feed burnability [---]	Burning zone temperature [°C]	Coal [tonne/h] [as-fired]	Coke [tonne/h] [as-fired]
	2013 11 04	Non-Responsive [redacted]																	
	2013 11 05																		
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102	2013 12 13																		
103	2013 12 14																		
104	20 13 12 15																		
105	2013 12 16																		
106	2013 12.17																		

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Appendix § III paragraph 8:		j	k	m				n		o	
		Fuel rates	Fuel distribution	Combustion air flow rates		NOx control reagent		Start-up, shut-down, malfunction documentation		Data gap documentation	
Operating days	Date	Gas [Nm^3/h] [as-fired]	Kiln burning zone [% heat]	Primary air [Nm^3/h]	Secondary air [Nm^3/h]	Type [—]	Rate [l/min]	Incident type	Explanation	Missing data	Explanation
1	2013.07.31	[redacted]									
2	2013.08.01										
3	2013.08.02										
4	2013.08.03										
5	2013.08.04										
6	2013.08.05										
7	2013.08.06										
8	2013.08.07										
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Appendix § III paragraph 8: Operating days	Date	j Fuel rates Gas [Nm^3/h] [as-fired]	k Fuel distribution Kiln burning zone [% heat]	m Combustion air flow rates Primary air [Nm^3/h]	Secondary air [Nm^3/h]	NOx control reagent Type [---]	Rate [L/min]	n Start-up, shut-down, malfunction documentation Incident type	Explanation	o Data gap documentation Missing data	Explanation
	2013.09.17	[redacted]									
36	2013.09.18										
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50	2013.10.02										
51	2013.10.03										
52	2013.10.04										
53	2013.10.05										
54	2013.10.06										
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	2013.11.04	Non-Responsive [redacted]									
	2013.11.05										
	2013.11.06										
	2013.11.07										
	2013.11.08										
	2013.11.09										
	2013.11.10										
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83	2013.11.24										
84	2013.11.25										
85	2013.11.26										
86	2013.11.27										
87	2013.11.28										
88	2013.11.29										
89	2013.11.30										
90	2013.12.01										
91	2013.12.02										
92	2013.12.03										
93	2013.12.04										
94	2013.12.05										
95	2013.12.06										
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97	2013.12.08										
98	2013.12.09										
99	2013.12.10										
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102	2013.12.13										
103	2013.12.14										
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106	2013.12.17										

END OF REPORT